Comparison of Trunk and Hip Strength and Flexibility between Pilots with and without a Self-Reported History of Low Back Pain

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INTRODUCTION

- Low back pain (LBP) is one of the most common musculoskeletal issues facing military personnel, with a high prevalence reported in helicopter pilots
- Although several risk factors (age, history of LBP, total flight-hours, total night-vision goggle flight-hours) have been previously identified, modifiable musculoskeletal characteristics have not been investigated in this population

PURPOSE

- The purpose of the study was to compare trunk and hip muscular strength and range-of-motion (ROM) in pilots with and without a self-reported history of LBP

SUBJECTS

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- A total of 31 pilots with LBP history (29 males/2 females) were matched on gender, age (± 5yrs), and total flight-hour (± 500hrs)
- Demographics and flight characteristics (flight experience, total flight-hour, total night-vision goggle (NVG) flight-hour, and 12-month flight-hour) are shown below

	LBP	Non-LBP
Age (years)	31.5 ± 5.9	31.4 ± 5.5
Height (cm)	177.1 ± 6.3	176.9 ± 8.8
Mass (kg)	84.4 ± 11.3	82.9 ± 14.6
Flight Experience (years)	6.5 ± 5.7	5.9 ± 4.4
Total Flight-Hour (hours)	1292.6 ± 1317.5	1291.8 ± 1312.3
Total NVG Fight-Hour (hours)	270.3 ± 345.6	290.8 ± 314.9
12-month Flight-Hour (hours)	184.0 ± 127.0	236.5 ± 187.1

NMRL Website Poster

EXPERIMENTAL DESIGN AND METHODS

EQUIPMENT

- The Biodex System 3 PRO dynamometer (Biodex, Shirley, NY) was used for trunk and hip strength testing
- A digital inclinometer (The Saunders Group, Chaska, MN) was used for passive hip and active lumbar spine ROM testing

PROCEDURES

- All pilots reported to the Warrior Human Performance Laboratory and performed two-hour laboratory testing to evaluate the trunk and hip musculoskeletal characteristics

TRUNK STRENGTH TESTING

- For trunk flexion/extension and rotation strength testing, pilots performed five maximal isokinetic concentric reciprocal contractions at the 60 degrees/second (Figure 1-2)
- Strength was measured as average peak torque normalized to body weight (%BW)

FIGURE 1: Trunk Flex/Ext Strength

FIGURE 2: Trunk Rot Strength

HIP STRENGTH TESTING

- For hip abduction strength testing, pilots performed three maximal isometric contractions for 5 seconds with 10 seconds rest between contractions
- Strength was measured as average peak torque normalized to body weight (%BW)

HIP RANGE-OF-MOTION TESTING

- For hip internal/external rotation passive ROM testing, an examiner rotated pilots' hip maximally while keeping the pelvis on the table
- The average of three trials in degrees (°) were used for statistical analyses

LUMBAR SPINE RANGE-OF-MOTION TESTING

- For lumbar extension ROM testing, pilots were prone and actively pressed up into extension, keeping the hips on the table (Figure 3)
- For lumbar flexion ROM testing, pilots were seated and "slumped" forward into flexion (Figure 4)
- For lumbar lateral flexion ROM testing, pilots were standing and instructed to slide the fingers down as far as possible (Figure 5)
- For lumbar rotation ROM testing, pilots were standing and instructed to rotate the trunk as far as possible while the arms on the chest and the hips at 90 degrees of flexion
- The lumbar ROM was calculated as the difference between the inclinometer values at T12 and L5
- The average of three trials in degrees (°) were used for statistical analyses

FIGURE 3: Lumbar Ext ROM

FIGURE 4: Lumbar Flex ROM

FIGURE 5: Lumbar Latflex ROM

STATISTICAL ANALYSIS

- Each variable was assessed for outliers and normality
- Paired t-tests or Wilcoxon tests were used to compare all variables between groups ($p < 0.05$)

RESULTS

- The LBP group demonstrated significantly less trunk extension strength (LBP: 345.5 ± 78.1%BW, non-LBP: 404.5 ± 66.0%BW, p = 0.004)
- The LBP group demonstrated significantly less trunk lateral flexion ROM towards right (LBP: 21.5 ± 4.1°, non-LBP: 26.4 ± 4.6°, p = 0.001) and left (LBP: 23.0 ± 4.4°, non-LBP: 26.8 ± 4.7°, p = 0.005)

Strength (%BW)	LBP	Non-LBP	p-value
Trunk Flexion	234.6 ± 46.8	242.4 ± 49.3	0.554
Trunk Extension	345.5 ± 78.1	404.5 ± 66.0	0.004*
R Trunk Rotation	138.6 ± 25.5	144.5 ± 29.6	0.460
L Trunk Rotation	134.8 ± 28.2	141.2 ± 28.2	0.431
R Hip Abduction	151.3 ± 30.5	153.0 ± 30.5	0.805
L Hip Abduction	157.9 ± 26.8	160.2 ± 29.1	0.740
Range-of-Motion (°)	**LBP**	**Non-LBP**	**p-value**
Lumbar Flexion	17.2 ± 7.2	20.1 ± 8.7	0.176
Lumbar Extension	47.7 ± 8.0	50.1 ± 7.3	0.203
R Lumbar Lateral Flexion	21.5 ± 4.1	26.4 ± 4.6	0.001*
L Lumbar Lateral Flexion	23.0 ± 4.4	26.8 ±4.7	0.005*
R Lumbar Rotation	9.4 ± 3.2	11.4 ± 3.9	0.061
L Lumbar Rotation	9.5 ± 2.9	10.8 ± 3.8	0.232
R Hip Internal Rotation	46.9 ± 9.0	46.9 ± 10.4	0.994
L Hip Internal Rotation	46.7 ± 9.2	45.8 ± 11.3	0.704
R Hip External Rotation	60.1 ± 7.7	60.6 ± 7.7	0.845
L Hip External Rotation	60.7 ± 7.9	61.3 ± 9.8	0.837

SUMMARY AND CONCLUSIONS

- The current investigation revealed musculoskeletal characteristics that are associated with pilots with a self-reported history of LBP
- Further research on other neuromuscular factors (e.g. trunk proprioception, posture, and balance) is warranted

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